Attachment A. Formulation of Alternatives

The formulation of alternatives was an iterative process consisting of brainstorming, fatal flaw analysis, initial cost comparisons, and screening criteria. The process involved meetings with interdisciplinary staff from ND, CD, ESO, and CALFED. The alternatives were also discussed with the Tehama-Colusa Canal Authority and USBR during Technical Advisory Group meetings.

The objective of the formulation process was to identify a reasonable number of alternatives that would be retained for further study. In selecting alternatives for this study, the goal was to provide the decision-makers with an array of alternatives. As such, each alternative can be viewed as representing a reasonable design configuration for that type of alternative.

In general, the screening process considered criteria that tended to make one alternative more or less favorable when compared to another alternative. However, as mentioned above, the process attempted to retain at least one alternative of each type for comparison. The following factors were primary considerations for deferral or retention of an alternative:

Engineering feasibility. Site conditions were assessed to determine the feasibility of constructing a new diversion along the Sacramento River. A stable bank or "hardened point" was considered a minimum requirement for the location to be deemed feasible. Although a difficult site could be made feasible, it was deferred under these criteria if costly measures would be required.

Capital cost. While all costs should be included when making comparisons, the initial screening process compared only capital or construction costs. The operations and maintenance costs are not included in the comparison nor are the costs annualized over the life of the project. During the screening process, costs were compared between alternatives in order to defer alternatives whose costs were significantly higher than the costs of the retained alternatives.

Environmental issues. The initial screening process considered known environmental impacts that would make the alternative very unlikely to be implemented. Examples of such "fatal flaws" would be potential impacts to endangered species. Staff from ESO is studying fishery, plant, wildlife, archeological and related impacts of the conveyance alternatives.

Institutional issues. Would there be significant public opposition to the alternative? By itself this factor would not cause an alternative to be deferred but combined with other unfavorable factors could provide adequate justification for deferral. Institutional issues would also include those related to the operation or implementation of an alternative. Such issues could limit the flexibility of operations.

Representative alternative. An alternative may be deferred if it is similar to another alternative that will be retained for further study. An alternative may be retained in order to provide a comparison of different types of alternatives.

Other factors not considered during the initial screening process but necessary for future comparisons include operational flexibility, land acquisition and operations and maintenance costs, site limitations, drainage issues, and mitigation costs.

During the initial brainstorming process, a number of alternatives were eliminated for not meeting the initial scope of this study although they could potentially provide water to an offstream storage reservoir at Sites. Other alternatives were eliminated later during the screening process when they were determined to have unacceptable high costs or had unstable site conditions at the diversion location. At various times during the formulation process, the number of alternatives would fluctuate as ones were eliminated while new ones were added. Ultimately, five primary alternatives were identified for this study and described in the main report. Three of the alternatives have options or variations based on different components.

The following list describes alternatives that were considered for study during the formulation process and the reason(s) for deferral in this study.

Alternatives considered outside the scope of this study:

- Diversion from existing Black Butte Reservoir to enlarged Tehama-Colusa Canal between Stony Creek near Orland and Funks Reservoir.
- New 5,000 cfs canal flowing south from Black Butte Reservoir to Funks Reservoir.
- New 5,000 cfs canal flowing north from Berryessa Reservoir to Funks Reservoir.
- New 5,000 cfs tunnel and canal system flowing northeasterly from Clear Lake to Funks Reservoir.
- Butte Sink or other diversions from east of the Sacramento River.

Alternatives deferred for engineering reasons:

- New Sacramento River diversion and intertie north of Chico Landing to enlarged 5,000 cfs Tehama-Colusa Canal (similar to Chico Landing Intertie).
- New Sacramento River diversion and intertie north of Chico Landing to enlarged 5,000 cfs Glenn-Colusa Canal, then to Funks Reservoir.
- Sacramento River diversion and intertie south of Maxwell Road back northwesterly to Funks Reservoir.

Alternatives deferred because of high costs:

- Divert from an enlarged Colusa Basin Drain to a new canal (near Maxwell Road) to Funks Reservoir.

Alternatives deferred for institutional reasons:

- Series of interconnections from Sacramento River to Colusa Basin Drain, CBD to Glenn-Colusa Canal, and Glenn-Colusa Canal to Tehama-Colusa Canal and Funks Reservoir.

Alternatives deferred for environmental reasons:

- Divert from Sacramento River near Highway 162 and Butte City to an enlarged Colusa Basin Drain to a new canal (near Delevan Road) to Funks Reservoir.

Alternatives represented by other alternatives to be studied:

- Divert from Sacramento River to a new canal (near Maxwell Road) to Funks Reservoir.
- Use existing Tehama-Colusa Canal with a diversion from an enlarged Colusa Basin Drain to a new canal (near Delevan Road) to Funks Reservoir.
- Use existing Tehama-Colusa and Glenn-Colusa Canals and Colusa Basin Drain to Funks Reservoir.

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Attachment B. Design Assumptions and Criteria

The conveyance alternatives design assumptions and criteria describe pre-feasibility level studies of alternatives for diverting and conveying 5,000 cfs to existing Tehama-Colusa Canal/Funks Reservoir for the proposed Sites Reservoir offstream storage project.

General:

- The level of study for this report is pre-feasibility for general alternative conveyance facility comparison and selection purposes.
- The four alternative water sources for offstream reservoir storage are the Tehama-Colusa Canal, Glenn-Colusa Canal, Colusa Basin Drain, and new Sacramento River diversion at, or downstream of, Chico Landing.
- No boundary or topographic survey work has been performed. All work is based on U.S. Geological Survey quad maps, existing reports, data and visual field observations.
- No field geologic observations, borings, soil tests, or detailed research has been performed. Limited geologic data was obtained from existing reports and discussions with various agency geologists, soil scientists, and other technical staff.
- No Sacramento River, Colusa Basin Drain, Tehama-Colusa Canal, or Glenn-Colusa Canal hydrology, operations, routing, or other studies are included in the study scope.
- ND is doing reservoir sizing, hydrology, operation analysis, pre-design, and other related storage facility work.
- Environmental research, assessment, evaluations, and similar work are being done by ESO. Environmental considerations are being discussed between ND, CD, and ESO.
- Several of the alternatives could be modified or utilized in the larger Colusa/Sites offstream water storage reservoir alternative.
- Pumping works necessary to lift diverted water from Funks Reservoir into Sites Reservoir will be studied by ND.
- Preliminary right of way ownership, where available, is based on the latest available property ownership maps.
- Preliminary conveyance design is based on DWR design manuals and CALFED facility descriptions for Chico Landing Intertie and Tehama-Colusa Canal Enlargement.
- Preliminary alternative conveyance facility costs are based on CALFED cost criteria and recently constructed comparable facilities.
- Institutional constraints, interagency agreements and cost sharing are beyond the scope of this report at this time.

- Detailed planning, design, and construction scheduling are beyond the scope of this report at this time.

Preliminary capital and construction costs are the only costs included in the alternative screening process. Annual operations and maintenance costs, which vary depending on the pumping head, type of canal lining, length of canal, and other factors, will be developed for the alternatives selected for further study.

The initial 12 conveyance alternatives were screened down to three or four alternatives for further study between March and September 1998.

Tehama-Colusa Canal:

- Existing Tehama-Colusa Canal plans and data were furnished by USBR; and related information was gathered from existing reports, visual observation, and discussions.
- Facility descriptions and preliminary costs for the Tehama-Colusa Canal are based on, and described in, the CALFED Tehama-Colusa Canal enlargement report.
- Chico Landing Intertie and Tehama-Colusa Canal facility descriptions and preliminary costs for the CL/TC intertie and enlargement are based on, and described in, the CALFED Chico Landing Intertie and Tehama-Colusa Canal enlargement reports.
- Alternatives involving the Tehama-Colusa Canal are assumed not to adversely affect existing delivery capability or schedules, cross drainage, institutional constraints, or other existing factors.

Glenn-Colusa Canal:

- Glenn-Colusa Canal data was furnished by GCID and gathered from existing reports, visual observations, and discussions.
- Alternatives involving the Glenn-Colusa Canal are assumed not to adversely affect existing delivery capability or schedules, cross drainage, institutional constraints, or other existing factors.
- GCID is presently planning to expand the existing 450-foot-long fish screen to approximately 1,000 feet. The extension would not provide additional capacity beyond existing capability.

Colusa Basin Drain:

- Funks Reservoir is the terminal point for CD conveyance study alternatives.
- Colusa Basin Drain data was gathered from existing reports, observations, and discussions.
- Alternatives involving the Colusa Basin Drain are assumed not to adversely affect existing delivery capability or schedules, agricultural return flows, cross drainage, institutional constraints or other existing factors.
- No fish screen requirement is assumed for the Colusa Basin Drain.

Sacramento River:

- CALFED's Chico Landing diversion facility and fish screens descriptions and costs are assumed applicable to other alternative Sacramento River diversions points.
- Sacramento River water rights and diversions are assumed not a factor (for winter period peak flood flow diversions to Funks Reservoir) for this study.
- Sacramento River data was gathered from DWR Flood Operations Center reports, USGS water resources data reports, ND observations, and discussions.
- Alternatives involving Sacramento River diversions are assumed not to adversely affect existing delivery capability or schedules, institutional constraints, or other existing factors.
- For preliminary screening purposes, diversion from the river is assumed to be allowed above a minimum flood flow of 20,000 cfs. (This may be revised because of environmental, water surface elevation, or other reasons.)
- For preliminary screening purposes, diversion from the river is assumed to be allowed up to the maximum river flow following 24-hour 60,000 cfs flushing period. (This may be revised because of environmental, water surface elevation, or other reasons.)

Attachment C. Unit Costs

(Tables C-1 through C-4)

Table C-1. Funks Reservoir Diversions Canal Reaches/Alternatives Matrix, Proposition 204 North of the Delta Storage Facility Studies

No.	Alternative	Diversion to Funks (cfs)	Canal	Canal Reaches: No.	Q(max) (cfs)	Length: Station (1000 ft) (a)	Length: Distance (unit cost) (b)	Length: Distance (Miles)	Status	From	To	Canal Lined	Pumping Plants	Canal Costs (a x b)
I A	TC+GC/NC4A	3,900	TC	all	2,100	350.02	0	66.29	Existing	RBPP	Funks	Yes	0	0.0
	Includes existing		GC	all	1,800	212.00	0	40.15	Existing	HCPP	NC	No	0	0.0
	2,100 cfs TC and		NC	all	1,800	10.60	0.50	2.01	New	GC	TC	Yes	2	5.3
	1,800 cfs GC		TC	last	3,900	2.50	0.35	0.47	Enlarge	NC	Funks	Yes	0	0.9
	Total													**$6.2**
B	TC+GC/NC4B	3,900	TC	all	2,100	352.52	0	66.77	Existing	RBPP	Funks	Yes	0	0.0
	Includes existing		GC	all	1,800	212.00	0	40.15	Existing	HCPP	NC	No	0	0.0
	2,100 cfs TC and		NC	all	1,800	14.00	0.50	2.65	New	GC	Funks	Yes	2	7.0
	1,800 cfs GC													
	Total													**$7.0**
II A	TC+GC/NC4A	5,000	TC	all	2,500	350.02	0.05	66.29	Enlarge	RBPP	NC	Yes	0	17.5
	Includes enlarging		GC	all	2,500	148.11	0.00	28.05	Existing	HCPP	I5	Yes	0	0.0
	existing TC and GC		GC	all	2,500	63.89	0.35	12.10	Enlarge	I5	NC	Yes	0	22.4
	to 2,500 cfs each		NC	all	2,500	10.60	0.65	2.01	New	GC	TC	Yes	2	6.9
			TC	last	5,000	2.50	0.44	0.47	Enlarge	NC	Funks	Yes	0	1.1
	Total													**$47.9**

No.	Alternative	Diversion to Funks *(cfs)*	Canal	Canal Reaches No.	Q(max) *(cfs)*	Length Station *(1000 ft)* (a)	Length Distance *(unit cost)* (b)	Length Distance *(Miles)*	Status	From	To	Canal Lined	Pumping Plants	Canal Costs (a x b)
B	TC+GC/NC4B	5,000	TC	all	2,500	352.52	0.05	66.77	Enlarge	RBPP	NC	Yes	0	17.6
	Includes enlarging		GC	all	2,500	63.89	0.35	12.10	Enlarge	I5	NC	Yes	0	22.4
	existing TC and GC		NC	all	2,500	14.00	0.65	2.65	New	GC	Funks	Yes	2	9.1
	to 2,500 cfs each													
	Total													**$49.1**
III	TC+GC+CD/NC	8,000	TC	all	2,100	352.52	0	66.77	Existing	RBPP	Funks	Yes	1	0
	Utilizes 2,100 cfs		GC	1	2,900	72.60	0	13.75	Existing	HCPP	JC	No	0	0
	from existing		GC	2	2,900	139.40	0.04	26.4	Enlarge	JC	NC	No	0	5.6
	RBPP Diversion		NC	1	3,000	30.40	0.20	5.76	New	CD	PP1	No	0	6.1
	Facilities		NC	2	3,000	17.00	0.54	3.22	New	PP1	PP2	Yes	1	9.1
			NC	3	5,900	2.50	0.69	0.47	New	PP2	PP3	Yes	1	1.7
			NC	4	5,900	11.00	0.69	2.65	New	PP3	Funks	Yes	1	7.6
	Total													**$30.1**
IV A	GC+CD/NC	8,000	GC	all	5,000	212.00	0.13	40.15	Enlarge	HCPP	NC	No	1	27.6
	Includes new		NC	1	3,000	30.40	0.20	5.76	New	CD	PP1	No	0	6.1
	2,000 cfs HCPP		NC	2	3,000	17.00	0.54	3.22	New	PP1	PP2	Yes	1	9.1
	Diversion		NC	3	8,000	2.50	0.76	0.47	New	PP2	PP3	Yes	1	1.9
	Facilities		NC	4	8,000	11.00	0.76	2.08	New	PP3	Funks	Yes	1	8.4
	Total													**$53.0**
B	GC/CLI+CD/NC	8,000	CLI	1	2,000	7.20	0.46	1.40	New	SR	GC	No	1	3.3
	Includes new		GC	1	2,900	56.00	0	10.61	Existing	HCPP	CLI	No	0	0
	2,100 cfs CLI		GC	2	5,000	16.60	0.17	3.14	Enlarge	CLI	JC	No	0	2.8
	Diversion		GC	3	5,000	139.40	0.17	26.40	Enlarge	JC	NC	No	0	23.7
	Facilities		NC	1	3,000	30.40	0.20	5.76	New	CD	PP1	No	0	6.1
			NC	2	3,000	17.00	0.54	3.22	New	PP1	PP2	Yes	1	9.1
			NC	3	8,000	2.50	0.76	0.47	New	PP2	PP3	Yes	1	1.9
			NC	4	8,000	11.00	0.76	2.08	New	PP3	Funks	Yes	1	8.4
	Total													**$55.3**

Table C-1

No.	Alternative	Diversion to Funks *(cfs)*	Canal	Canal Reaches: No.	Q(max) *(cfs)*	Length: Station *(1000 ft)* (a)	Length: Distance *(unit cost)* (b)	Length: Distance *(Miles)*	Status	From	To	Canal Lined	Pumping Plants	Canal Costs (a x b)
V	NC/SR+CD/NC	8,000	NC	1A	5,000	15.20	0.28	2.88	New	SR	CD	No	0	4.3
	Includes new		NC	1	8,000	30.40	0.36	5.76	New	CD	PP1	No	0	10.9
	5,000 cfs NC		NC	2	8,000	17.00	0.76	3.22	New	PP1	PP2	Yes	1	12.9
	Diversion		NC	3	8,000	2.50	0.76	0.47	New	PP2	PP3	Yes	1	1.9
	Facilities		NC	4	8,000	11.00	0.76	2.08	New	PP3	Funks	Yes	1	8.4
	Total													**$38.4**
VI A	TC+NC/SR+CD/NC	8,000	TC	all	2,100	352.52	0	66.77	Existing	RBPP	Funks	Yes	0	0
	Utilize 2,100 cfs from		NC	1A	2,900	15.20	0.20	2.88	New	SR	CD	No	0	3.0
	existing RBPP & new		NC	1	5,900	30.40	0.31	5.76	New	CD	PP1	No	0	9.4
	2,900 cfs Diversion		NC	2	5,900	17.00	0.69	3.22	New	PP1	PP2	Yes	1	11.7
	Facilities opposite		NC	3	5,900	2.50	0.69	0.47	New	PP2	PP3	Yes	1	1.7
	Moulton Weir		NC	4	5,900	11.00	0.69	2.65	New	PP3	Funks	Yes	1	7.6
	Total													**$33.4**
B	GC+NC/SR+CD/NC	8,000	GC	all	1,800	212.00	0	40.15	Existing	HCPP	NC	No	0	0
	Includes 3,200 cfs		NC	1A	3,200	15.20	0.21	2.88	New	SR	CD	No	0	3.1
	new Diversion		NC	1	6,200	30.40	0.32	5.76	New	CD	PP1	No	0	9.7
	Facilities opposite		NC	2	6,200	17.00	0.70	3.22	New	PP1	PP2	Yes	1	11.9
	Moulton Weir		NC	3	6,200	2.50	0.70	0.47	New	PP2	PP3	Yes	1	1.8
			NC	4	6,200	11.00	0.70	2.08	New	PP3	Funks	Yes	1	7.7
	Total													**$34.2**

No.	Alternative	Diversion to Funks *(cfs)*	Canal	Canal Reaches No.	Q(max) *(cfs)*	Length Station *(1000 ft)* (a)	Length Distance *(unit cost)* (b)	Length Distance *(Miles)*	Status	From	To	Canal Lined	Pumping Plants	Canal Costs (a x b)
VII A	TC+CD/NC	8,000	TC	all	5,000	352.52	0.44	66.77	Enlarge	RBPP	Funks	Yes	1	155.1
	Includes new		NC	1	3,000	30.40	0.20	5.76	New	CD	PP1	No	0	6.1
	5,000 cfs RBPP		NC	2	3,000	17.00	0.54	3.22	New	PP1	PP2	Yes	1	9.1
	Diversion		NC	3	3,000	2.50	0.69	0.47	New	PP2	PP3	Yes	1	1.7
	Facilities		NC	4	3,000	11.00	0.69	2.65	New	PP3	Funks	Yes	1	7.6
	Total													**$179.6**
B	TC/CLI+CD/NC	8,000	CLI	1	5,000	6.00	0.64	1.14	New	SR	PP1	Yes	1	3.8
	Includes new		CLI	2	5,000	22.20	0.64	4.20	New	PP1	PP2	Yes	1	14.2
	5000 cfs CLI		CLI	3	5,000	22.00	0.64	4.17	New	PP2	PP3	Yes	1	14.1
	Diversion		CLI	4	5,000	7.40	0.64	1.40	New	PP3	TC	Yes	1	4.7
	Facilities		TC	2	5,000	169.83	0.44	32.17	Enlarge	CLI	Funks	Yes	0	74.7
			NC	1	3,000	30.40	0.20	5.76	New	CD	PP1	No	0	6.1
			NC	2	3,000	17.00	0.54	3.22	New	PP1	PP2	Yes	1	9.1
			NC	3	3,000	2.50	0.69	0.47	New	PP2	PP3	Yes	1	1.7
			NC	4	3,000	11.00	0.69	2.08	New	PP3	Funks	Yes	1	7.6
	Total													**$136.1**

Abbreviations

CD Colusa Basin Drain
CLI Chico Landing Intertie
PP Pumping Plant
HC Hamilton City
MW Moulton Weir
NC New Canal
GC Glenn-Colusa Canal
TC Tehama-Colusa Canal
RB Red Bluff Diversion Dam
SR Sacramento River
JC Jacinto Check
DP Direct Payment to Contractor
Funks Funks Reservior

Table C-1

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Table C-2. Funks Reservoir Conveyance Canal Major Feature Costs, Proposition 204 North of the Delta Storage Facility Studies ($ millions DP only)

Alt. No.		Alternative	New Major Structure			Enlarged Major Structure			TOTAL COST
			Quantity	Avg. Unit Cost	Total Cost	Quantity	Avg. Unit Cost	Total Cost	
I	**A**	TC+GC/NC4A							
		Check Structure	2	4.3	8.6	0	0	0	8.6
		Canal Siphon	0	0	0.0	0	0	0	0.0
		Highway Bridge	0	0	0.0	0	0	0	0.0
		County Road Bridge	2	2.5	5.0	0	0	0	5.0
		Railroad Siphon	0	0	0.0	0	0	0	0.0
		Drainage Crossing	2	0.5	1.0	0	0	0	1.0
		Total [1]			**14.6**			**$0.0**	**$14.6**
	B	TC+GC/NC4B							
		Check Structure	2	4.3	8.6	0	0	0	8.6
		Canal Siphon	1	0	0.0	0	0	0	0.0
		Highway Bridge	0	0	0.0	0	0	0	0.0
		County Road Bridge	2	2.5	5.0	0	0	0	5.0
		Railroad Siphon	0	0	0.0	0	0	0	0.0
		Drainage Crossing	2	0.5	1.0	0	0	0	1.0
		Total [1]			**14.6**			**$0.0**	**$14.6**
II	**A**	TC+GC/NC4A							
		Check Structure	2	4.7	9.4	0	0	0.0	9.4
		Canal Siphon	0	0	0.0	0	0	0.0	0.0
		Highway Bridge	0	0	0.0	0	0	0.0	0.0
		County Road Bridge	2	2.7	5.4	0	0	0.0	5.4
		Railroad Siphon	0	0	0.0	0	0	0.0	0.0
		Drainage Crossing	2	0.5	1.0	0	0	0.0	1.0
		Total [1]			**15.8**			**$0.0**	**$15.8**

Alt. No.		Alternative	New Major Structure Quantity	New Major Structure Avg. Unit Cost	New Major Structure Total Cost	Enlarged Major Structure Quantity	Enlarged Major Structure Avg. Unit Cost	Enlarged Major Structure Total Cost	TOTAL COST
	B	TC+GC/NC4B							
		Check Structure	2	4.7	9.4	0	0	0	9.4
		Canal Siphon	1	0	0.0	0	0	0	0.0
		Highway Bridge	0	0	0.0	0	0	0	0.0
		County Road Bridge	2	2.7	5.4	0	0	0	5.4
		Railroad Siphon	0	0	0.0	0	0	0	0.0
		Drainage Crossing	2	0.5	1.0	0	0	0	1.0
		Total [1]			**15.8**			**$0.0**	**$15.8**
III		**TC+GC+CD/NC**							
		Check Structure	6	4.5	27.0	6	1.6	9.5	36.5
		Canal Siphon	1	18.8	18.8	2	6.6	13.2	32.0
		Highway Bridge	3	6.3	18.9	3	2.2	6.6	25.5
		County Road Bridge	6	2.7	16.2	12	0.9	10.8	27.0
		Railroad Siphon	1	19	18.8	1	6.6	6.6	25.4
		Drainage Crossing	8	0.6	4.8	21	0.2	4.2	9.0
		Total [1]			**$ 104.5**			**$ 50.8**	**$155.3**
IV	**A**	**GC+CD/NC**							
		Check Structure	6	4.5	27.0	6	1.6	9.6	36.6
		Canal Siphon	1	18.8	18.8	3	6.6	19.8	38.6
		Highway Bridge	3	6.3	18.9	3	2.2	6.6	25.5
		County Road Bridge	6	2.7	16.2	17	0.9	16.1	32.3
		Railroad Siphon	1	18.8	18.8	1	6.6	6.6	25.4
		Drainage Crossing	8	0.6	4.8	26	0.2	5.2	10.0
		Total [1]			**$ 104.6**			**$ 63.8**	**$168.4**

Alt. No.		Alternative	New Major Structure			Enlarged Major Structure			TOTAL COST
			Quantity	Avg. Unit Cost	Total Cost	Quantity	Avg. Unit Cost	Total Cost	
	B	**GC/CLI+CD/NC**							
		Check Structure	7	4.5	31.5	5	1.6	7.9	39.4
		Canal Siphon	2	18.8	37.7	0	6.6	0.0	37.7
		Highway Bridge	3	6.3	18.9	2	2.2	4.4	23.3
		County Road Bridge	7	2.7	18.9	13	0.9	12.3	31.2
		Railroad Siphon	1	18.8	18.8	1	6.6	6.6	25.4
		Drainage Crossing	8	0.6	4.8	23	0.2	4.6	9.4
		Total [1]			**$ 130.6**			**$ 35.8**	**$166.4**
V		**NC/SR+CD/NC**							
		Check Structure	7	4.5	31.5	0	1.6	0.0	31.5
		Canal Siphon	2	18.8	37.7	0	6.6	0.0	37.7
		Highway Bridge	4	6.3	25.2	0	2.2	0.0	25.2
		County Road Bridge	6	2.7	16.2	0	0.9	0.0	16.2
		Railroad Siphon	1	18.8	18.8	0	6.6	0.0	18.8
		Drainage Crossing	9	0.6	5.4	0	0.2	0.0	5.4
		Total [1]			**$ 134.8**			**$0.0**	**$134.8**
VI	**A**	**TC+NC/SR+CD/NC**							
		Check Structure	7	4.5	31.5	0	1.6	0.0	31.5
		Canal Siphon	2	18.8	37.7	0	6.6	0.0	37.7
		Highway Bridge	4	6.3	25.2	0	2.2	0.0	25.2
		County Road Bridge	6	2.7	16.2	0	0.9	0.0	16.2
		Railroad Siphon	1	18.8	18.8	0	6.6	0.0	18.8
		Drainage Crossing	9	0.6	5.4	0	0.2	0.0	5.4
		Total [1]			**$ 134.8**			**$0.0**	**$134.8**
	B	**GC+NC/SR+CD/NC**							
		Check Structure	7	4.5	31.5	0	1.6	0.0	31.5
		Canal Siphon	2	18.8	37.7	0	6.6	0.0	37.7
		Highway Bridge	4	6.3	25.2	0	2.2	0.0	25.2
		County Road Bridge	6	2.7	16.2	0	0.9	0.0	16.2
		Railroad Siphon	1	18.8	18.8	0	6.6	0.0	18.8
		Drainage Crossing	9	0.6	5.4	0	0.2	0.0	5.4
		Total [1]			**$ 134.8**			**$0.0**	**$134.8**

Alt. No.	Alternative	New Major Structure			Enlarged Major Structure			TOTAL COST
		Quantity	Avg. Unit Cost	Total Cost	Quantity	Avg. Unit Cost	Total Cost	
VII	**TC+CD/NC**							
	Check Structure	6	4.5	27.0	17	1.6	26.8	53.8
	Canal Siphon	1	18.8	18.8	4	6.6	26.4	45.2
	Highway Bridge	3	6.3	18.9	3	2.2	6.6	25.5
	County Road Bridge	6	2.7	16.2	31	0.9	29.3	45.5
	Railroad Siphon	1	18.8	18.8	4	6.6	26.4	45.2
	Drainage Crossing	8	0.6	4.8	15	0.2	3.0	7.8
	Total [1]			**$ 104.6**			**$ 118.4**	**$223.0**
B	**TC/CLI+CD/NC**							
	Check Structure	7	4.5	31.5	5	1.6	7.9	39.4
	Canal Siphon	3	18.8	56.5	0	6.6	0.0	56.5
	Highway Bridge	3	6.3	18.9	3	2.2	6.6	25.5
	County Road Bridge	15	2.7	40.5	4	0.9	3.8	44.3
	Railroad Siphon	1	18.8	18.8	1	6.6	6.6	25.4
	Drainage Crossing	17	0.6	10.2	4	0.2	0.8	11.0
	Total [1]			**$ 176.4**			**$ 25.7**	**$202.1**

Abbreviations

CD Colusa Basin Drain
CLI Chico Landing Intertie
PP Pumping Plant
HC Hamiltion City
MW Moulton Weir
NC New Canal
GC Glenn-Colusa Canal
TC Tehama-Colusa Canal
Funks Funks Reservior
SR Sacramento River
DP Direct Payment to Contractor
RB Red Bluff Diversion Dam
JC Jacinto Check

Footnotes [1] This total is included in the total cost summary, Table 2

Table C-3. Funks Reservoir Diversions Pumping Plants, Proposition 204 North of the Delta storage Facility Studies ($ millions DP only)

No.		Alternative	Diversion to Funks *(cfs)*	Pumping Plants						
				Canal	Plant Name	Status	Q(max) *(cfs)*	H(net) *(ft)*	Power *(mw)*	Cost
I	A	TC+GC/NC4A	3,900	TC	RBPP	Existing	2,100	25	0	0
		Includes existing		GC	HCPP	Existing	2,900	0	0	0.0
		2100 cfs TC and		NC1	NC PP1	New	1,800	35	5.9	21.8
		1800 cfs GC		NC2	NC PP2	New	1,800	100	16.9	27.0
		Total [1]								**$48.8**
	B	TC+GC/NC4B	3,900	TC	RBPP	Existing	2,100	25	0	0
		Includes existing		GC	HCPP	Existing	2,900	0	0	0.0
		2100 cfs TC and		NC1	NC PP1	New	1,800	35	5.9	21.8
		1800 cfs GC		NC2	NC PP2	New	1,800	100	16.9	27.0
		Total [1]								**$48.8**
II	A	TC+GC/NC4A	5,000	TC	RBPP	Replacement	2,500	25	5.8	0
		Includes enlarging		GC	HCPP	Existing	2,900	0	0	0.0
		existing TC and GC		NC1	NC PP1	New	2,500	35	8.2	23.0
		to 2500 cfs each		NC2	NC PP2	New	2,500	100	23.4	28.0
		Total [1]								**$51.0**

No.		Alternative	Diversion to Funks *(cfs)*	Pumping Plants						
				Canal	Plant Name	Status	Q(max) *(cfs)*	H(net) *(ft)*	Power *(mw)*	Cost
	B	TC+GC/NC4B	5,000	TC	RBPP	Replacement	2,500	25	5.8	0
		Includes enlarging		GC	HCPP	Existing	2,900	0	0	0.0
		existing TC & GC		NC1	NC PP1	New	2,500	35	8.2	23.0
		to 2,500 cfs each		NC2	NC PP2	New	2,500	100	23.4	28.0
		Total [1]								**$51.0**
III		TC+GC+CD/NC	8,000	TC	RBPP	Replacement	2,100	25	4.9	0.0
		Utilizes 2,100 cfs		GC	HCPP	Existing	2,900	0	0	0.0
		from existing		NC	NC PP1	New	3,000	45	12.7	25.0
		RBPP Diversion		NC	NC PP2	New	46,000	35	19.4	26.3
		Facilities		NC	NC PP3	New	5,900	100	55.5	31.5
		Total [1]								**$82.8**
IV	**A**	GC+CD/NC	8,000	GC	HCPP	Existing	3,000	0	0	0.0
		Includes new		GC	HCPP	Enlarge	2,000	20	3.8	19.2
		2,000 cfs HCPP		NC	NC PP1	New	3,000	45	12.7	25.0
		Diversion		NC	NC PP2	New	8,000	35	26.3	28.0
		Facilities		NC	NC PP3	New	8,000	100	75.2	33.5
		Total [1]								**$105.7**
	B	GC/CLI+CD/NC	8,000	GC	HCPP	Existing	3,000	0	0	0.0
		Includes new		CLI	CL PP1	New	2,000	30	5.6	21.0
		2,100 cfs CLI		NC	NC PP1	New	3,000	45	12.7	25.0
		Diversion		NC	NC PP2	New	8,000	35	26.3	23.8
		Facilities		NC	NC PP3	New	8,000	100	75.2	28.7
		Total [1]								**$98.5**

No.		Alternative	Diversion to Funks *(cfs)*	Pumping Plants						
				Canal	Plant Name	Status	Q(max) *(cfs)*	H(net) *(ft)*	Power *(mw)*	Cost
V		NC/SR+CD/NC	8,000	NC	NC PP1	New	8,000	45	33.9	29.0
		Includes new		NC	NC PP2	New	8,000	35	26.3	28.0
		5,000 cfs NC		NC	NC PP3	New	8,000	100	75.2	33.5
		Diversion Facilities								
		Total [1]								**$90.5**
VI	**A**	TC+NC/SR+CD/NC	8,000	TC	RBPP	Replacement	2,100	25	4.9	0.0
		Includes 2,100 cfs new		NC	NC PP1	New	5,900	45	25.0	27.7
		Diversion Facilities		NC	NC PP2	New	5,900	35	19.4	26.3
		opposite MW		NC	NC PP3	New	5,900	100	55.5	31.5
		Total [1]								**$85.5**
	B	GC+NC/SR+CD/NC	8,000	GC	HCPP	Existing	1,800	0	0	0
		Includes 3,200 cfs new		NC	NC PP1	New	6,200	45	26.3	28.0
		Diversion Facilities		NC	NC PP2	New	8,000	35	26.3	28.0
		opposite MW		NC	NC PP3	New	8,000	100	75.2	33.5
		Total [1]						66.77		**$89.5**
VII	**A**	TC+CD/NC	8,000	TC	RBPP	Replacement	5,000	25	11.8	24.7
		Includes new		NC	NC PP1	New	3,000	45	12.7	25.0
		5,000 cfs RBPP		NC	NC PP2	New	3,000	35	9.8	23.8
		Diversion Facilities		NC	NC PP3	New	3,000	100	28.2	28.7
		Total [1]								**$102.2**

No.	Alternative	Diversion to Funks *(cfs)*	Pumping Plants						
			Canal	Plant Name	Status	Q(max) *(cfs)*	H(net) *(ft)*	Power *(mw)*	Cost
VII	B TC/CLI+CD/NC	8,000	CLI	CL PP1	New	5,000	35	16.5	25.2
	Includes new		CLI	CL PP2	New	5,000	40	18.8	26.0
	5000 cfs CLI		CLI	CL PP3	New	5,000	40	18.8	26.0
	Diversion		NC	NC PP1	New	3,000	45	12.7	25.0
	Facilities		NC	NC PP2	New	3,000	35	9.8	23.8
			NC	NC PP3	New	3,000	100	28.2	28.7
	Total [1]								**$154.7**

Abbreviations

CD Colusa Basin Drain	Funks Funks Reservior	JC Jacinto Check	TC Tehama-Colusa Canal
CLI Chico Landing Intertie	SR Sacramento River	DP Direct Payment to Contractor	MW Moulton Weir
PP Pumping Plant	GC Glenn-Colusa Canal	RB Red Bluff Diversion Dam	
NC New Canal	HC Hamiltion City		

Footnotes [1] This total is included in the total cost summary, Table 2.

Table C-4 Funks Reservoir Diversions Canal Right of Way/Alternatives Matrix
Proposition 204 North of the Delta Storage Facility Studies

No.		Alternative	Diversion to Funks *(cfs)*	Canal	Canal Reaches No.	Q(max) *(cfs)*	Area to be Acquired Length *(1000 ft)* (a)	Width *(feet)* (b)	Area *(acres)* (c)	Status	From	To	Canal Lined	Unit Cost *($millions/ac)* (d)	Right of Way Costs *(millions)* (c x d)
I	**A**	TC+GC/NC4A	3,900	TC	all	2,100	0	0	0	Existing	RBPP	NC	Yes	0	0
		Includes existing		GC	all	1,800	0	0	0	Existing	HCPP	NC	No	0	0
		2,100 cfs TC &		NC	1	1,800	3.00	275	19	New	GC/PP1	PP2	Yes	0.0005	0.0
		1,800 cfs GC		NC	2	1,800	7.60	275	48	New	PP2	TC	Yes	0.0005	0.0
				TC	last	3,900	2.50	30	2	Enlarge	NC	Funks	Yes	0.0005	0.0
		Total [1]													**$0.0**
	B	TC+GC/NC4B	3,900	TC	all	2,100	0	0	0	Existing	RBPP	Funks	Yes	0	0
		Includes existing		GC	all	1,800	0	0	0	Existing	HCPP	NC	No	0	0
		2,100 cfs TC &		NC	1	1,800	3.00	275	19	New	GC/PP1	PP2	Yes	0.0005	0.0
		1,800 cfs GC		NC	2	1,800	11.00	275	69	New	PP2	Funks	Yes	0.0005	0.0
		Total [1]										TC			**$0.0**
II	**A**	TC+GC/NC4A	5,000	TC	all	2,500	350.02	0	0	Enlarge	RBPP	NC	Yes	0	0
		Includes enlarging		GC	all	2,500	63.36	40	58	Enlarge	HCPP	NC	No	0.0030	0.2
		existing TC & GC		NC	1	2,500	3.00	300	21	New	GC/PP1	PP2	Yes	0.0005	0.0
		to 2,500 cfs each		NC	2	2,500	7.60	300	52	New	PP2	TC	Yes	0.0005	0.0
				TC	last	5,000	2.50	50	3	Enlarge	NC	Funks	Yes	0.0005	0.0
		Total [1]													**$0.2**
	B	TC+GC/NC4B	5,000	TC	all	2,500	352.52	0	0	Enlarge	RBPP	NC	Yes	0	0
		Includes enlarging		GC	all	2,500	63.36	40	58	Enlarge	HCPP	NC	No	0.0030	0.2
		existing TC & GC		NC	3	2,500	3.00	300	21	New	GC/PP1	PP2	Yes	0.0005	0.0
		to 2,500 cfs each		NC	2	2,500	11.00	300	76	New	PP2	Funks	Yes	0.0005	0.0
		Total [1]													**$0.2**

North of the Delta Offstream Storage Investigation

No.		Alternative	Diversion to Funks *(cfs)*	Canal	Canal Reaches No.	Q(max) *(cfs)*	Area to be Acquired Length *(1000 ft)* (a)	Width *(feet)* (b)	Area *(acres)* (c)	Status	From	To	Canal Lined	Unit Cost *($millions/ac)* (d)	Right of Way Costs *(millions)* (c x d)
III		TC+GC+CD/NC	8,000	TC	all	2,100	352.52	0	0	Existing	RBPP	Funks	Yes	0.0030	0
		Utilizes 2,100 cfs		GC	1	2,900	72.60	0	0	Existing	HCPP	JC	No	0	0
		from existing		GC	2	2,900	139.40	2,460	7,883	Enlarge	JC	NC	No	0.0030	23.6
		RBPP Diversion		NC	1	3,000	30.40	300	210	New	CD	PP1	No	0.0030	0.6
		Facilities		NC	2	3,000	17.00	300	117	New	PP1	PP2	Yes	0.0030	0.4
				NC	3	5,900	2.50	400	23	New	PP2	PP3	Yes	0.0005	0.0
				NC	4	5,900	11.00	400	101	New	PP3	Funks	Yes	0.0005	0.1
		Total [1]													**$24.7**
IV	**A**	GC+CD/NC	8,000	GC	all	5,000	212.00	200	975	Enlarge	HCPP	NC	No	0.0030	2.9
		Includes new		NC	1	3,000	30.40	300	210	New	CD	PP1	No	0.0030	0.6
		2,000 cfs HCPP		NC	2	3,000	17.00	300	117	New	PP1	PP2	Yes	0.0030	0.4
		Diversion		NC	3	8,000	2.50	500	29	New	PP2	PP3	Yes	0.0005	0.0
		Facilities		NC	4	8,000	11.00	500	126	New	PP3	Funks	Yes	0.0005	0.1
		Total [1]													**$4.0**
	B	GC/CLI+CD/NC	8,000	CLI	1	2,000	7.20	260	43	New	SR	GC	No	0.0030	0.1
		Includes new		GC	1	2,900	56.00	0	0	Existing	HCPP	CLI	No	0	0
		2,100 cfs CLI		GC	2	5,000	16.60	200	76	Enlarge	CLI	JC	No	0.0030	0.2
		Diversion		GC	3	5,000	139.40	200	641	Enlarge	JC	NC	No	0.0030	1.9
		Facilities		NC	1	3,000	30.40	300	210	New	CD	PP1	No	0.0030	0.6
				NC	2	3,000	17.00	300	117	New	PP1	PP2	Yes	0.0030	0.4
				NC	3	8,000	2.50	500	29	New	PP2	PP3	Yes	0.0005	0.0
				NC	4	8,000	11.00	500	126	New	PP3	Funks	Yes	0.0005	0.1
		Total [1]													**$3.3**

Table C-4

No.		Alternative	Diversion to Funks *(cfs)*	Canal	Canal Reaches No.	Q(max) *(cfs)*	Area to be Acquired Length *(1000 ft)* (a)	Width *(feet)* (b)	Area *(acres)* (c)	Status	From	To	Canal Lined	Unit Cost *($millions/ac)* (d)	Right of Way Costs *(millions)* (c x d)
V		NC/SR+CD/NC	8,000	NC	1A	5,000	15.20	375	131	New	SR	CD	No	0.0030	0.4
		Includes new		NC	1	8,000	30.40	500	349	New	CD	PP1	No	0.0030	1.0
		5,000 cfs NC		NC	2	8,000	17.00	500	195	New	PP1	PP2	Yes	0.0030	0.6
		Diversion		NC	3	8,000	2.50	500	29	New	PP2	PP3	Yes	0.0005	0.0
		Facilities		NC	4	8,000	11.00	500	126	New	PP3	Funks	Yes	0.0005	0.1
		Total [1]													**$2.1**
									67						
VI	**A**	TC+NC/SR+CD/NC	8,000	TC	all	2,100	352.52	0	0	Existing	RBPP	Funks	Yes	0	0
		Utilize 2,100 cfs from		NC	1A	2,900	15.20	300	105	New	SR	CD	No	0.0030	0.3
		existing RBPP & new		NC	1	5,900	30.40	400	280	New	CD	PP1	No	0.0030	0.8
		2,900 cfs Diversion		NC	2	5,900	17.00	400	156	New	PP1	PP2	Yes	0.0030	0.5
		Facilities opposite		NC	3	5,900	2.50	400	23	New	PP2	PP3	Yes	0.0005	0.0
		Moulton Weir		NC	4	5,900	11.00	400	101	New	PP3	Funks	Yes	0.0005	0.1
		Total [1]													**$1.7**
	B	GC+NC/SR+CD/NC	8,000	GC	all	1,800	212.00	0	0	Existing	HCPP	NC	No	0	0
		Includes 3,200 cfs		NC	1A	3,200	15.20	300	105	New	SR	CD	No	0.0030	0.3
		new Diversion		NC	1	6,200	30.40	400	280	New	CD	PP1	No	0.0030	0.8
		Facilities opposite		NC	2	6,200	17.00	400	156	New	PP1	PP2	Yes	0.0030	0.5
		Moulton Weir		NC	3	6,200	2.50	400	23	New	PP2	PP3	Yes	0.0005	0.0
				NC	4	6,200	11.00	400	101	New	PP3	Funks	Yes	0.0005	0.1
		Total [1]													**$1.7**

No.		Alternative	Diversion to Funks (cfs)	Canal	Canal Reaches No.	Q(max) (cfs)	Area to be Acquired Length (1000 ft) (a)	Width (feet) (b)	Area (acres) (c)	Status	From	To	Canal Lined	Unit Cost ($millions/ac) (d)	Right of Way Costs (millions) (c x d)
VII	**A**	TC+CD/NC	8,000	TC	all	5,000	352.52	125	1,013	Enlarge	RBPP	Funks	Yes	0.0030	3.0
		Includes new		NC	1	3,000	30.40	300	210	New	CD	PP1	No	0.0030	0.6
		5,000 cfs RBPP		NC	2	3,000	17.00	300	117	New	PP1	PP2	Yes	0.0030	0.4
		Diversion		NC	3	3,000	2.50	300	17	New	PP2	PP3	Yes	0.0005	0.0
		Facilities		NC	4	3,000	11.00	300	76	New	PP3	Funks	Yes	0.0005	0.0
		Total [1]													**$4.1**
	B	TC/CLI+CD/NC	8,000	CLI	1	5,000	6.00	360	50	New	SR	PP1	Yes	0.0030	0.1
		Includes new		CLI	2	5,000	22.20	360	184	New	PP1	PP2	Yes	0.0030	0.6
		5,000 cfs CLI		CLI	3	5,000	22.00	360	182	New	PP2	PP3	Yes	0.0030	0.5
		Diversion		CLI	4	5,000	7.40	360	61	New	PP3	TC	Yes	0.0030	0.2
		Facilities		TC	2	5,000	169.83	125	488	Enlarge	CLI	Funks	Yes	0.0030	1.5
				NC	1	3,000	30.40	300	210	New	CD	PP1	No	0.0030	0.6
				NC	2	3,000	17.00	300	117	New	PP1	PP2	Yes	0.0030	0.4
				NC	3	3,000	2.50	400	23	New	PP2	PP3	Yes	0.0005	0.0
				NC	4	3,000	11.00	400	101	New	PP3	Funks	Yes	0.0005	0.1
		Total [1]													**$3.9**

Abbreviations

CD Colusa Basin Drain
Funks Funks Reservior
CLI Chico Landing Intertie
RB Red Bluff Diversion Dam
NC New Canal
SR Sacramento River
DP Direct Payment to Contractor
PP Pumping Plant
GC Glenn-Colusa Canal
MW Moulton Weir
JC Jacinto Check
HC Hamiltion City

Footnotes [1] This total is included in the total cost summary, Table 2.

Attachment D. Documentation Data Index

A. Design Assumptions and Criteria

- Canal Design Criteria
- Criteria for Evaluation of Sacramento River Diversion Facilities for Offstream Storage
- Design of Hydraulic Structures

B. Formulation of Alternatives

- Maps for Alternatives I - VII
  1. ND 1498 and CD Work Plan
     - Sites Work Plan, Draft – November 18, 1998
     - Proposition 204 – January 22, 1998
     - Work Plan – December 10, 1997
  2. List of Detailed Assumptions
  3. Initial List of Alternatives
     - TAG meeting – July 22, 1998
     - CD Office Memo – Meeting July 7, 1998
     - CD Office Memo – Cost Requests July 15, 1998
     - ND Office Memo – Offstream Storage Operation Studies July 7, 1998
     - Miscellaneous Tables
     - Miscellaneous Maps
  4. USGS Quad Sheets
     - Tehama-Colusa Canal Service Area Map
     - Dams
     - Black Butte Reservoir
     - Sites Reservoir
     - Alternatives I-VII Breakdown Map
  5. Survey Data
  6. Geologic Data
     - Soil Types – North Canal, Chico Landing Intertie, South Canal
     - Soil Descriptions
  7. Hydrology and Hydraulic Data
     - Daily Flow Frequency Sacramento River at Colusa
     - Daily Flow Frequency Sacramento River at Butte City
     - Daily Flow Frequency Sacramento River at Bend Bridge
     - Excavation Quantities
     - Glenn-Colusa Canal
     - Integrated Resource Management Pamphlet
     - Comparison Map – Funks and Sites Reservoir
     - Projected Statistics – Small Sites, Large Sites, Colusa, Funks Reservoirs

State of California, Gray Davis, Governor
The Resources Agency, Mary D. Nichols, Secretary for Resources
Department of Water Resources, Thomas M. Hannigan, Director

Steve Macaulay, Chief Deputy Director
Raymond D. Hart, Deputy Director
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